REMARKS

[0001] Claims 1-30 are pending. The Office Action mailed 6/13/2006 (hereinafter "Office Action") objected to the specification because of a typographical error. The Office Action rejected claims 1-30 under 35 U.S.C. § 102(b) as being anticipated by William F. Renner, Jr., U.S. Patent No. 6,243,827 (hereinafter "Renner").

AMENDMENTS TO THE SPECIFICATION

[0002] The specification has been amended to correct obvious typographical errors and to address the objection listed in the Office Action. The amendments find full support in the specification, claims, and drawings.

AMENDMENTS TO THE CLAIMS

[0003] The claims have been amended to more particularly point out the features of the present invention. The amendments are fully supported by the specification, drawings, and other claims.

REJECTION OF CLAIMS 1-30 UNDER 35 U.S.C. §102(b)

[0004] The Examiner rejected claims 1-30 under 35 U.S.C. §102(b) as being anticipated by Renner. The Applicants respectfully traverse this rejection. "Anticipation under 35 U.S.C. §102 requires the disclosure in a single piece of prior art of each and every limitation of a claimed invention. ...Whether such art is anticipating is a question of fact." *Apple Computer, Inc. v. Articulate Systems, Inc.* 234 F.3d 14, 20, 57 USPQ2d 1057, 1061 (Fed. Cir. 2000). It is well settled that under 35 U.S.C. §102 "an invention is anticipated if . . . all the claim limitations [are] shown in a single art prior art reference. Every element of the claimed invention must be literally present, arranged as in the claim. The identical invention must be shown in as complete detail as is contained in the patent claim." *Richardson v. Suzuki Motor Co., Ltd.*, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989). In determining whether a prior art reference anticipates a claim, it is necessary to (1) determine the scope of Applicant's broadest claim, (2) determine exactly what the single prior art reference discloses, and (3) compare each and every claim limitation against

the prior art disclosure. *SSIH Equipment, S.A. v. U.S Int'l Trade Commission et al.*, 218 U.S.P.Q. 678, 688. Only if each limitation is literally disclosed by the prior art reference is the claim anticipated.

[0005] Initially, it may be useful to review the invention described in the application and the disclosures of the prior art. In general, the application describes maintaining data in an electronic storage array during multiple, concurrent drive failures within the storage array. Application of David A. Burton, et al., serial number 10/713,950, filed 11/14/2003 (hereafter "Application") at ¶ 1. Typical storage arrays, such as a redundant array of independent/ inexpensive disks ("RAID"), provide only single fault tolerant systems such that they can recover from a failure of one disk. *Id.* at ¶ 3. If more than one drive fails, it may become extremely difficult or impossible to recover data from the damaged drives. *Id.* Several approaches exist to minimize data loss due to drive failures. *Id.* at ¶ 4. One approach is to place the storage array in a read only mode after a disk failure to prevent new data written to the storage array from being lost. *Id.* Another approach is to allow data access after a failure, but to keep track of suspect data. *Id.* at ¶ 5. This approach allows access to failed drives, but also risks loss of new data written to the drives. *Id.* Another approach is to write data from a host to write cache or to a drive separate from the storage array and then "pin" the data there, not allowing it to be moved to the storage array until the failures are corrected. *Id.* at ¶ 6. This approach is limited by the size of the "pinned data drive." *Id.*

[0006] The present invention overcomes many or all of the drawbacks of the prior art approaches to limiting data loss after concurrent drive failures. *Id.* at ¶ 8. The claimed invention detects a first drive failure and enters a first operating mode in response to the failure. *Id.* at ¶¶ 10, 49, Fig. 4. The first operating mode includes taking the first drive off-line and placing the volume set in a modified read/write mode using non-failed drives of the volume set. *Id.* at ¶¶ 10, 38, 50, Fig. 4. The first operating mode may also comprise placement of the volume set in a critical state and notifying a user of the critical state and modified read/write mode. *Id.* at ¶¶ 49, 50, Fig. 4.

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[0007] The claimed invention also detects a second drive failure and then places the volume set in a second operating mode. *Id.* at ¶¶ 10, 54, Fig. 5. In the second operating mode, the volume set is placed in a read-only mode with the second failed drive in a degraded state. *Id.* at ¶¶ 10, 54, Fig. 5. The second operating mode may also comprise placement of the volume set in a critical state and notifying a user of the critical state and read-only mode. *Id.* at ¶ 55, Fig. 5. The read-only mode may comprise the storage controller attempting to first read data from the failed second drive and then attempting to read data from a pinned data drive. *Id.* at ¶¶ 64-66, Fig. 6. After the first drive is rebuilt, the volume set returns to the first operating mode until the second drive is rebuilt. *Id.* at ¶¶ 60-63, Fig. 5. In one embodiment, lost data is tracked in a bad block table and a bad stripe table. *Id.* at ¶¶ 57-59, Fig. 5.

[0008] By contrast, Renner is typical of the prior art identified in the Application and teaches facilitating recovery of data from RAID storage arrays after multiple failures by identifying corrupted data. Renner at abstract. Renner points out that RAID arrays may only recover from a single failure without data loss and that the invention is geared to identification of corrupt data after multiple disk failure so that good data may be recovered. *Id.* at col. 1, l. 21 to col. 2, l. 54. Renner keeps track of the corrupted data using a bad region table replicated on each disk. *Id.* Renner gives a very detailed description of initializing tables, time-stamping entries, detecting bad data, stripping data across a RAID array, and other aspects of tracking corrupted data. *See generally id.* Renner does not describe or suggest entering a first or second operating mode, as described above, after a first or second drive failure. Renner does not describe a pinned data drive.

[0009] With regard to claim 1, the Office Action states that Renner discloses: "a primary response module . . . configured to recognize a failure of a first drive and enter a first operating mode in response to the failure of the first drive" and cites Figures 10 and 12 and column 11, lines 31-36 of Renner. Office Action at pp. 2-3. In addition, with respect to claim 2, the Office Action states that Renner discloses that "the primary response module is further configured to place the first drive in an off-line state" and again cites column 11, lines 36-40 of Renner. *Id.* at p. 3. The Applicants disagree. Figure 10 and the cited text describe a process that occurs *after* a

write process has been completed. Renner at col. 11, ll. 31-33 ("Fig. 10 is a flowchart of the process which is performed when a write operation to the storage array *has been* completed, successfully or unsuccessfully, by the controller") (emphasis added). The next sentence then only inferentially describes a situation where there is a failure and states that the process of Figure 10 will be invoked only after a certain number of retries has been performed. *Id*. at col. 11, ll. 34-36.

[0010] The following sentence then states that when there is only one failure and the array has redundancy, the failed drive may be removed prior to the process of Figure 10 and the write process will be considered a success. *Id*. at col. 11, ll. 36-40. The cited text does not state that the invention of Renner senses the first failed drive or takes the drive off-line, but instead describes a process that occurs after the drive is taken off line during a data recovery process.

[0011] In addition, the first element of amended claim 1 requires that the primary response module places the volume set in a modified read/write mode using non-failed drives of the volume set. Amended claim 1, *supra*. Figure 10 of Renner, the associated text, and the rest of Renner only describes tracking bad data and restoring data after a failure. Renner at Fig. 10, col. 10, ll. 32-59; *see generally id*. Figure 12 of Renner only describe a process after an error during a read operation. *Id*. at col. 12, ll. 13-15. The process of Figure 12 then attempts to reconstruct data to satisfy the read operation. *Id*. at col. 12, ll. 13-53, Fig. 12. Renner does not describe sensing a drive failure and then placing the volume set in a first operating mode where the failed drive is off-line and the remaining drives continue to operate in a modified read/write mode. Instead, Renner only describes a bad data tracking process and using the bad data tracking process to restore data.

[0012] As for the second element of claim 1, the Office Action states that Renner discloses "a primary response module configured to recognize a failure of a second drive and enter a second operating mode in response to the failure of the second drive" and cites column 5, lines 25-50 of Renner. Office Action at pp. 2-3. With regard to claim 3, the Office Action states that Renner discloses that "the secondary response module is further configured to place the second drive in a degraded state" and cites again column 11, lines 36-40 of Renner. *Id*. at p. 3.

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The Applicants disagree. The cited text in column 5 only states that the invention is useful for identifying the sites in the storage array of bad data and for recovery of correct data after a failure for various RAID configurations. Renner at col. 5, ll. 25-50.

[0013] As described above, the cited text in column 11 only describes a recovery process that occurs after a single failed disk is removed from operation. *Id.* at col. 11, ll. 36-40. The cited text does not describe sensing a second failure or entering a second operating mode. In addition, amended claim 1 further describes the second operating mode as placing the drives of the volume set in a read-only mode with the failed second drive in a degraded state. Amended claim 1, *supra*. The degraded state is further defined as allowing attempts to read requested data from the failed second drive and then from a pinned data drive if the data is unavailable from the failed second drive. *Id.* Renner does not disclose sensing a second failure in a drive, but only discusses data recovery after such an occurrence. Renner also does not discuss placing a volume set in a second operating mode as described in amended claim 1.

[0014] The Applicants respectfully assert that Renner does not disclose the limitations of amended claim 1 and therefore does not anticipate amended claim 1. The Applicants respectfully assert that amended claim 1 is in condition for allowance. The arguments in favor of claim 1 are also equally applicable to independent claims 14, 15, 17, and 30 and the Applicant respectfully assert they are in condition for allowance.

[0015] With respect to amended claim 2, the Applicants respectfully assert that Renner does not disclose or suggest placing a volume set in a critical state, but instead only describes bad data tracking and recovery. The Applicants respectfully assert claim 2 is in condition for allowance. The arguments in favor of amended claim 2 apply equally to amended claim 18 and the Applicants similarly assert that claim 18 is in condition for allowance.

[0016] With respect to amended claim 3, the Applicants respectfully assert that Renner does not disclose or suggest notifying a user that the volume set is in a critical state and assert that amended claim 3 is in condition for allowance. The arguments in favor of amended claim 3 apply equally to amended claim 19 and the Applicants similarly assert that claim 19 is in condition for allowance.

[0017] With respect to amended claim 4, the Applicants respectfully assert that Renner does not disclose returning the volume set to the a normal state if the first failed drive is rebuilt and not detecting a second drive failure and assert that amended claim 4 is in condition for allowance. The arguments in favor of amended claim 4 apply equally to amended claim 20 and the Applicants similarly assert that claim 20 is in condition for allowance.

[0018] With regard to claim 5, the Office Action states that Renner discloses "a pinned data module configured to store write data on a pinned data drive during employment of the second operating mode" and cites Figure 1, elements 60 and 61. Office Action at p. 3. The Applicants disagree. Elements 60 and 61 are described in Renner as spare drives connected to a SCSI hot spare disk bus 90. Renner at col. 6, ll. 50-52. There is no other mention of spare drives or any use for the spare drives in Renner other than that hot spare drives can be used to quickly replace failed drives. *See generally id.*; *id.* at col. 1, ll. 40-43, col. 5, ll. 2-6, col. 6, l. 67 to col. 7, l. 3. There is no mention in Renner of any pinned data drive or something similar. In addition, amended claim 5 makes it clear that the pinned data module stores write data intended for storage on the volume set on a pinned data drive without storing the write data on a drive of the volume set during the second operating mode. Amended claim 5, *supra*. The Applicants respectfully assert that amended claim 5 is in condition for allowance. The arguments in favor of amended claim 5 apply equally to amended claim 21 and the Applicants similarly assert that claim 21 is in condition for allowance.

[0019] With regard to claim 6, the Office Action states that Renner discloses "the pinned data drive is a system cache of the electronic storage array" and cites Figure 10 of Renner. Office Action at p. 4. The Applicants disagree. Figure 10 of Renner only describes checking data after a write operation to determine if the data contains bad data and then repairing the data if possible. Renner at Fig. 10, col. 11, ll. 31-59. Renner does not disclose pinned data, but instead only describes tracking corrupt data and recovering data after a failure. The Applicants respectfully assert that claim 6 is in condition for allowance. The arguments in favor of amended claim 6 apply equally to amended claim 22 and the Applicants similarly assert that claim 22 is in condition for allowance.

[0020] With regard to claim 7, the Office Action states that Renner discloses "the pinned data drive is a spare drive of the electronic storage array" and cites Figure 1, elements 60 and 61 of Renner. Office Action at p. 4. The Applicants disagree. Renner never describes any use for the spare drives 60, 61 of Figure 1 for anything other than replacement of failed drives. Renner does not disclose using the drives as pinned data drives. The Applicants respectfully assert that claim 7 is in condition for allowance. The arguments in favor of amended claim 7 apply equally to amended claim 23 and the Applicants similarly assert that claim 23 is in condition for allowance.

[0021] With regard to claim 8, the Office Action states that Renner discloses that "the pinned data module is further configured to map a first data location on the pinned data drive to a second data location on another drive within the electronic storage array" and cites column 12, lines 21-24 of Renner. Office Action at p. 4. The Applicants disagree. The cited text states that "[a]dditionally, the block containing physically flawed media may be remapped to a different location, either automatically by the storage device or using the SCSI REASSIGN BLOCKS (0.times.07) command." Renner at col. 12, ll. 21-24. The cited text does not discuss mapping to the spare data drives 60, 61, which the Office Action previously stated were the pinned data drives. *See* Office Action at p. 4. The process of Figure 12 describes remapping of corrupt data. *See* Renner at Fig. 12, col. 12, ll. 13-53. Claim 5, from which claim 8 depends, describes that the pinned data module stores write data intended for storage on the volume set on the pinned data drive without storing the data on a drive of the volume set during the second operating mode. Amended claim 5, *supra*. Write data in the pinned data drive is not corrupt data. The process for mapping of corrupt data described in Renner is not analogous to mapping write data from the pinned data drive to another drive of the volume set. The Applicants respectfully assert that claim 8 is in condition for allowance. The arguments in favor of amended claim 8 apply equally to amended claim 24 and the Applicants similarly assert that claim 24 is in condition for allowance.

[0022] With respect to claims 10 and 11, the Office Action cites Figure 1, element 34 and column 12, lines 13-33 as evidence that Renner anticipates at least partially rebuilding the data

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on the first drive on a spare drive and using the data on the pinned data drive. Office Action at p. 4. The Applicants disagree. There is no element 34 on Figure 1 or any other figure of Renner. *See generally* Renner. The cited text in column 12 relates to Figure 12 of Renner and only describes a process performed after "a MEDIUM ERROR status on a read." *Id.* at col. 12, ll. 13-15. The process does not describe rebuilding a first failed drive. As discussed above, Renner does not discuss the use of a pinned data drive. The Applicants respectfully assert that claims 10 and 11 are in condition for allowance. The arguments in favor of amended claims 10 and 11 apply equally to amended claims 25-27 and the Applicants similarly assert that claims 25-27 are in condition for allowance.

[0023] With respect to claim 14, the Office Action states that Renner discloses the elements of claim 14. Office Action at pp. 5-6. The Applicants disagree. The Applicants assert that Renner does not anticipate claim 14 for the same reasons stated above that Renner does not anticipate claims 1 and 5. The Applicants respectfully assert that claim 14 is in condition for allowance.

[0024] The Applicants assert that claims 2-13, 16, 18-29 are allowable because they depend on allowable claims and the Office Action has failed to describe how Renner anticipates the claims. The Applicants assert that claims 1-30 are not anticipated by Renner and are allowable. Should additional information be required, the Examiner is respectfully asked to notify the Applicants of such need. If any impediments to the prompt allowance of the claims can be resolved by a telephone conversation, the Examiner is respectfully requested to contact the undersigned.

Respectfully submitted,

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